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(54) **METHOD AND APPARATUS FOR PRESSURIZING GAS**

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(51) **Int. Cl.**[7] **F04B 9/08**
(52) **U.S. Cl.** **417/390**; 417/44.2; 417/384
(58) **Field of Search** 417/390, 199.1, 417/384, 44.2

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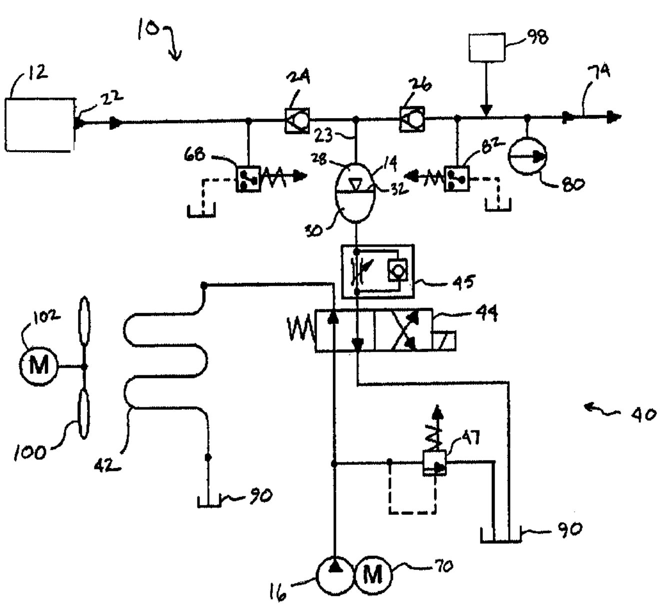
(57) **ABSTRACT**

A system and method for compressing gas uses a hydraulic pump and a hydraulic accumulator to compress gases in gaseous form. The accumulator is divided into a hydraulic chamber and a pneumatic chamber. The pneumatic chamber of the accumulator can be pneumatically connected to a gas supply and a gas receptacle that needs filled. One-way directional flow valves are used to permit the flow of gas from the gas supply to the pneumatic chamber and from the pneumatic chamber to the gas receptacle, but to prevent the flow of gas in the opposite direction. A motor drives the hydraulic pump, which moves pressurized oil into the hydraulic chamber of the accumulator. The pressurized oil within the hydraulic chamber of the accumulator compresses the gas within the pneumatic chamber of the accumulator, forcing the into a tank or other receptacle that needs filled. The invention can be used to compress a variety of gases at different flow rates, volumes, and pressures. The hydraulic pump can be driven by a single-phase or three-phase electric motor, or a gas or diesel powered motor.

7 Claims, 7 Drawing Sheets



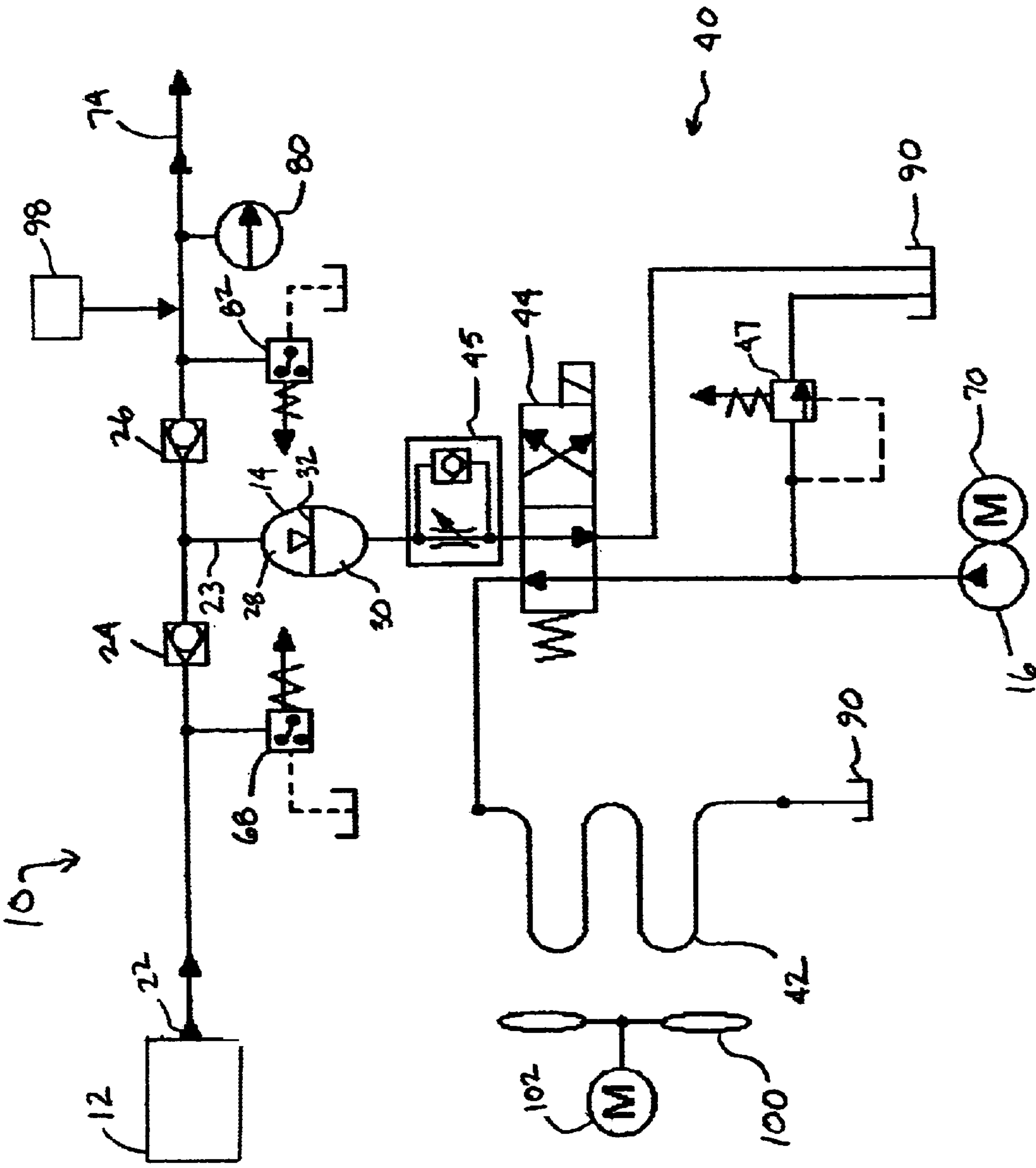

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FIG. 1

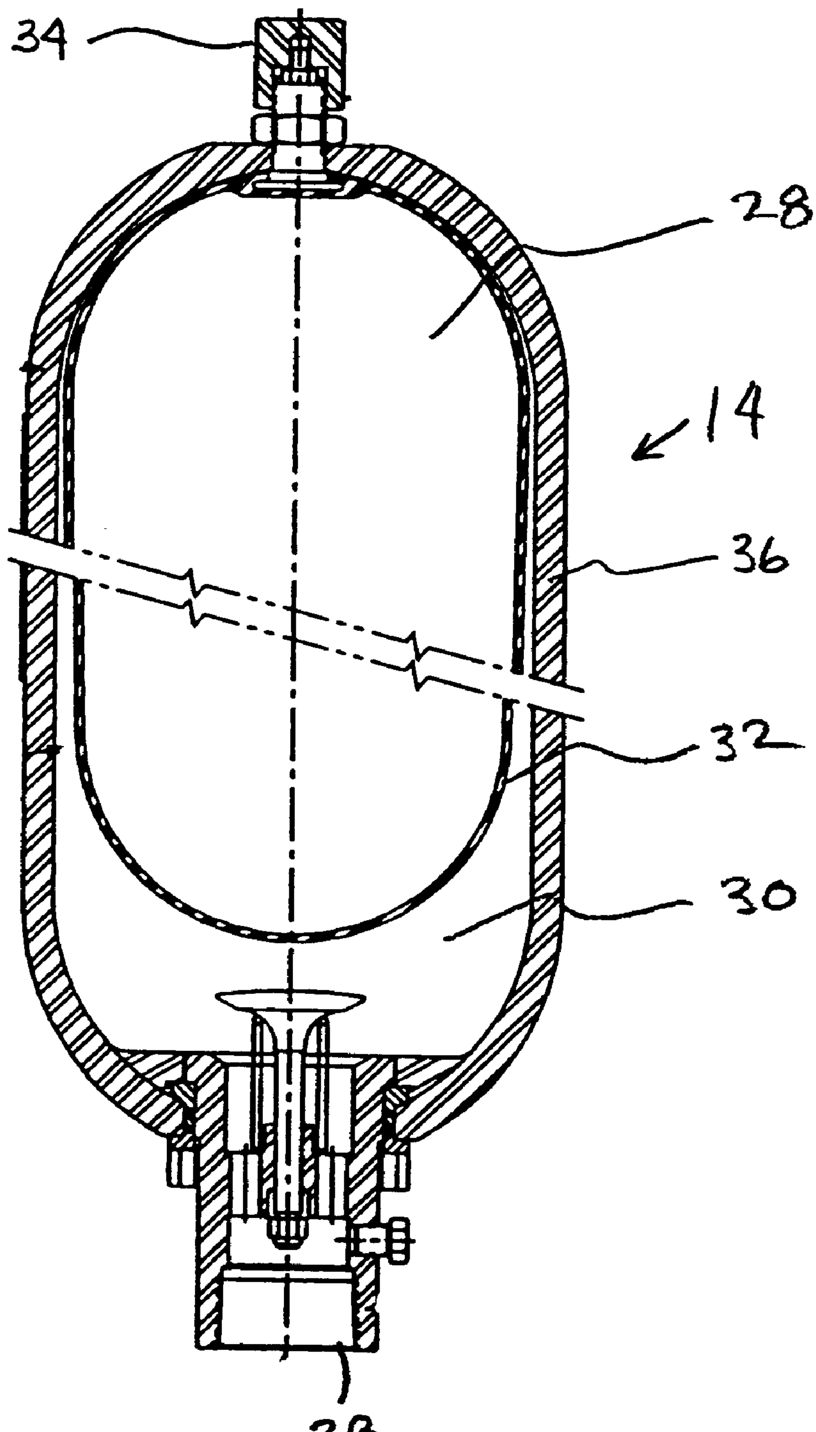


FIG 2

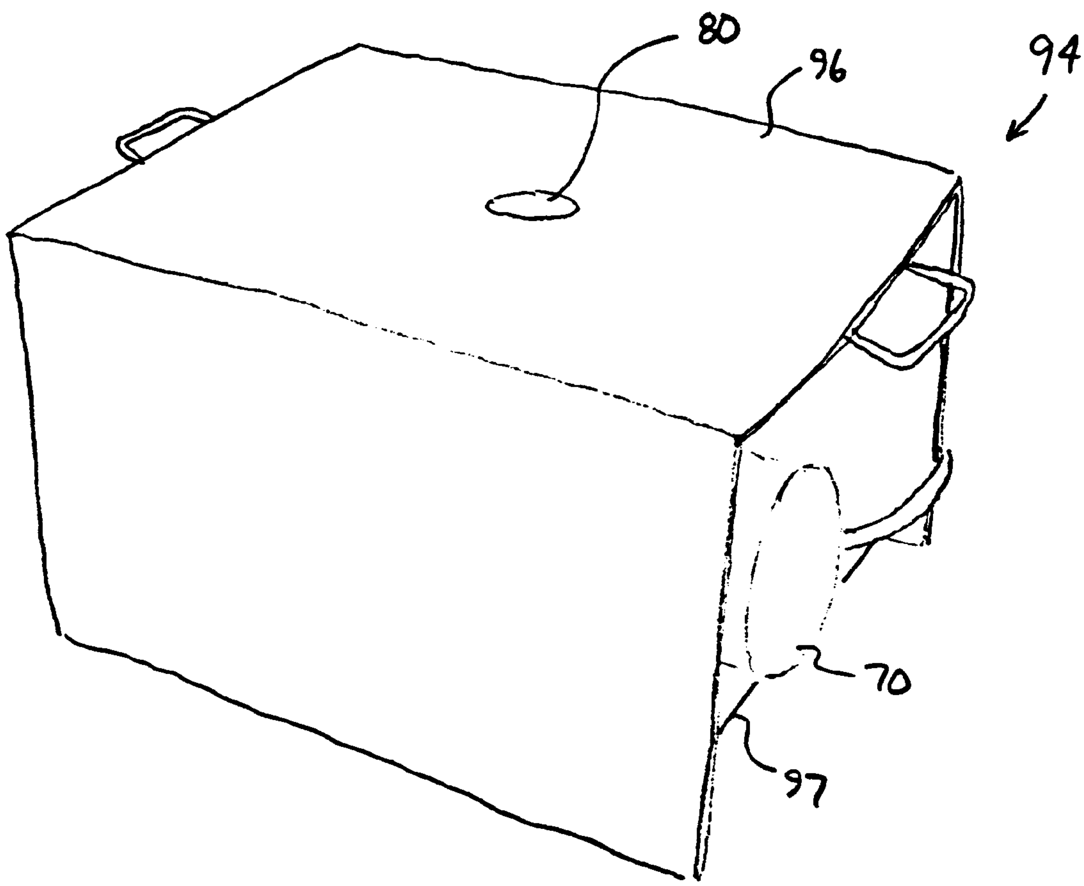
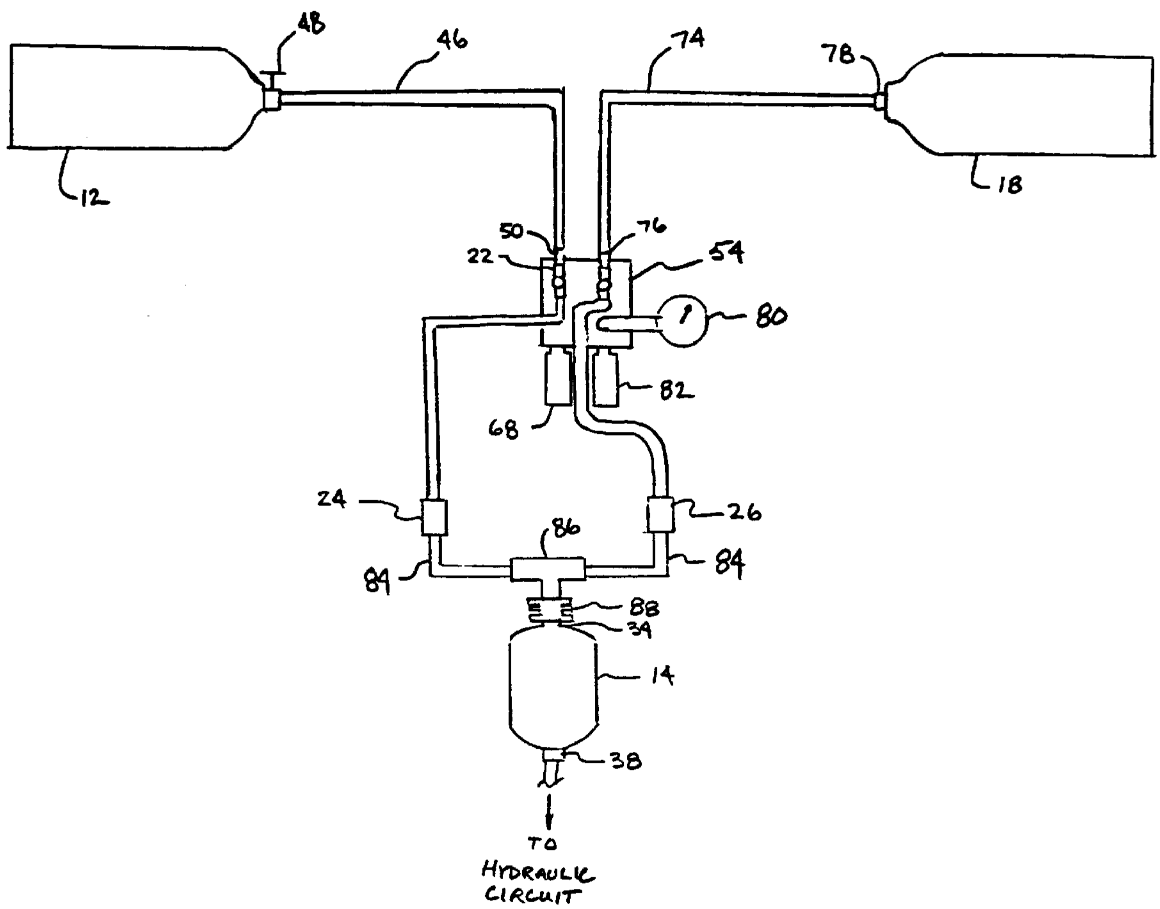


FIG 3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TO
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CIRCUIT

FIG 4

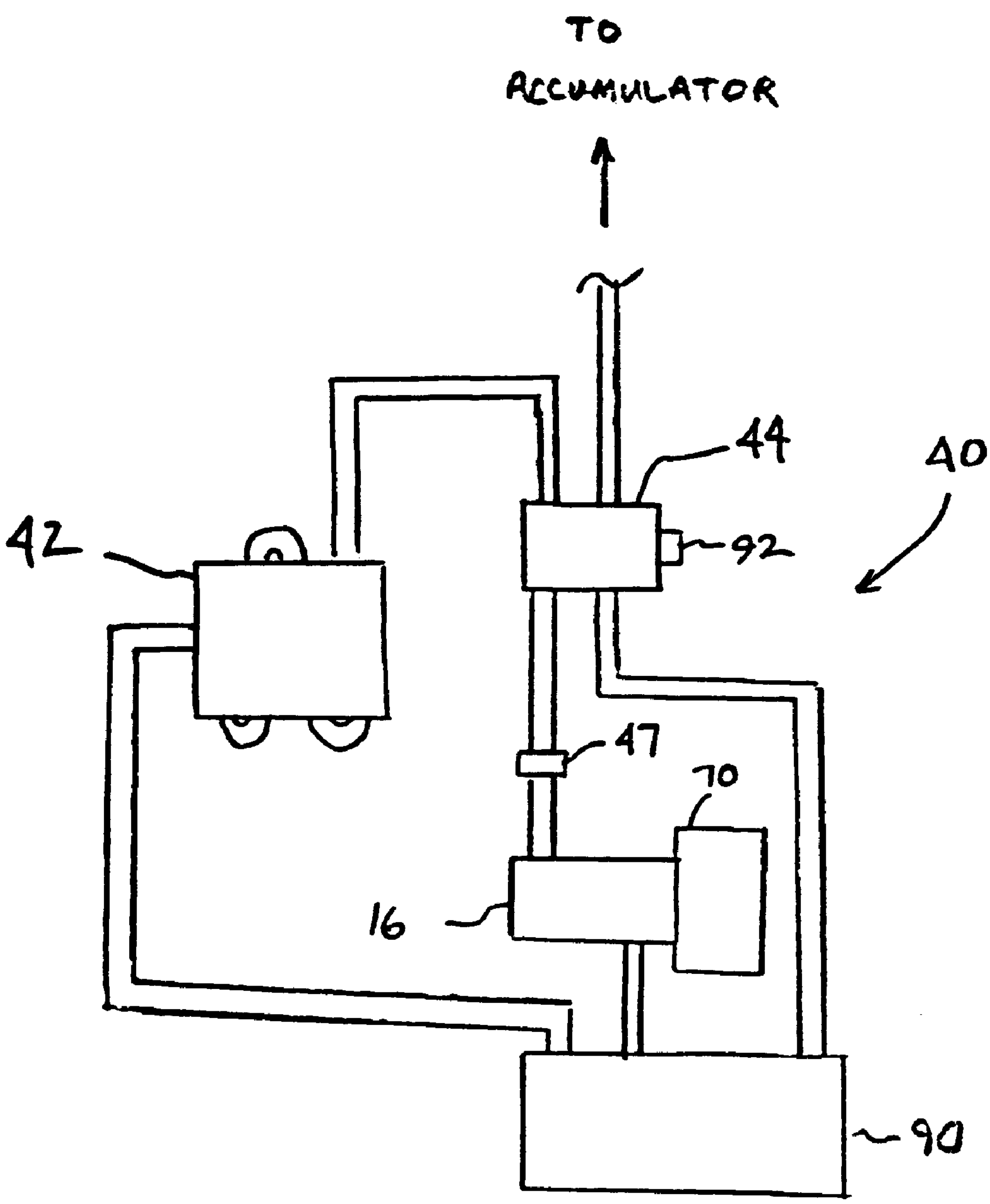

FIG 5

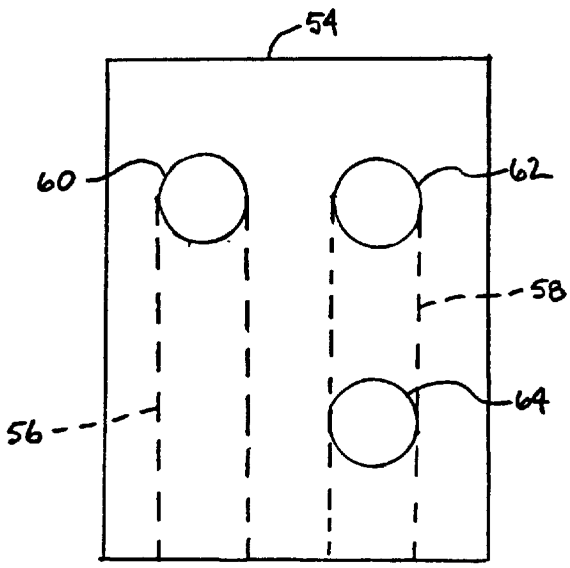

FIG 6A

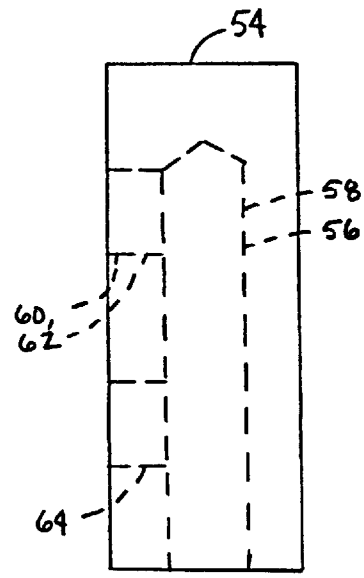

FIG 6B

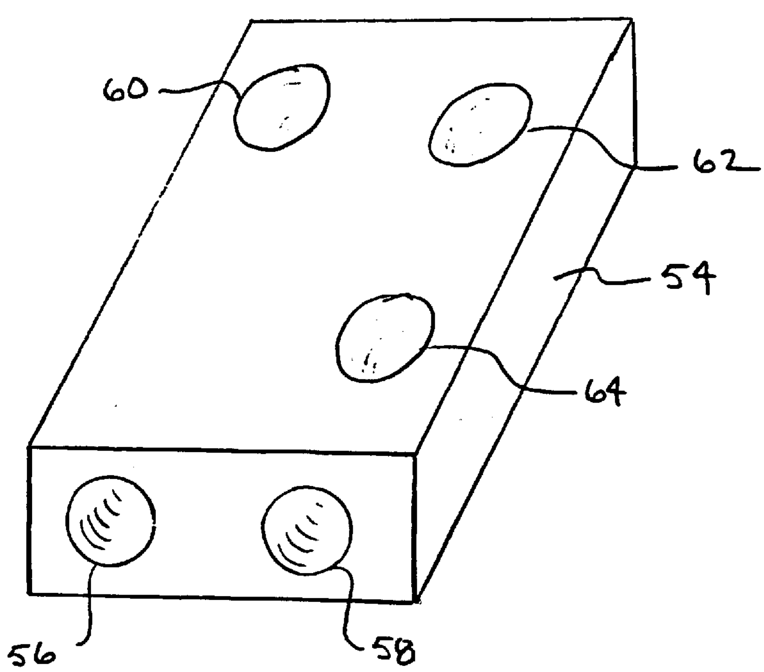

FIG 7

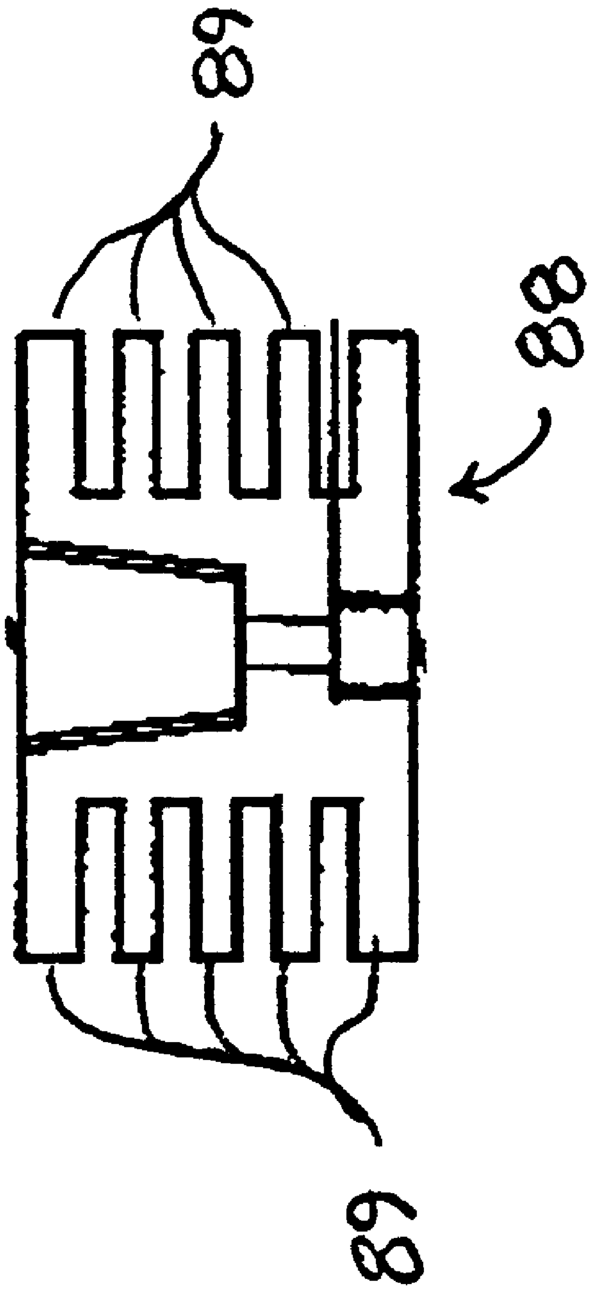

FIG 8

METHOD AND APPARATUS FOR PRESSURIZING GAS

TECHNICAL FIELD

This invention relates generally to an intensifier for increasing the pressure in a gas supplied at a relatively low pressure at an input port and exhausted at an increased pressure at an output port. More specifically, the invention relates to an intensifier that utilizes a hydraulic pump to pressurize hydraulic fluid in a bladder-type accumulator to compress a gas within the bladder. A preferred use of the intensifier is to recharge nitrogen tanks on Howitzer guns that are known as equilibrators or recuperators.

BACKGROUND OF THE INVENTION

Many devices and processes use pressurized gas. One common method of supplying such pressurized gas is through the use of a tank that is filled with a pressurized gas. A valve on the tank permits the delivery of the gas at a high pressure to whatever device is driven by the gas. As the gas is eliminated from the tank, the pressure within the tank declines. After sufficient use, the pressure in the tank is so low that it does not provide gas at an optimal pressure. Eventually, the tank will need to be refilled, or replaced with a full tank. One common method of refilling the spent tanks is to attach them directly to a supply cylinder that is filled with pressurized gas. The pressure difference between the two containers causes gas to flow from the supply cylinder to the tank, eventually filling the tank to the required pressure.

A disadvantage of this method of filling spent tanks is that the tank cannot be filled to a pressure greater than the supply cylinder that it being used to fill it. As the supply cylinder is used, it loses pressure, and cannot be used to fill any spent tanks after its pressure drops to at or near the desired pressure of the tanks. Therefore, much of the gas in the supply cylinders is not utilized, and it is necessary to refill the supply cylinders even though they have pressurized gas remaining in them.

A known method for pressuring gas is the use of a piston and cylinder pump. While such devices are effective in pressurizing the gas, they are often susceptible to either contamination of the gas, or leakage of the gas, around the seals and gaskets that are necessary in such devices.

Therefore, there exists a need for a method and apparatus that permits filling of depleted tanks through the use of supply cylinders, even when the pressure in the supply cylinder is below the desired pressure of the tank. Preferably, the method and apparatus would be resistant to contamination or loss of the compressed gas around gaskets and seals.

SUMMARY OF THE INVENTION

The invention is directed to a gas compressor that uses a hydraulic pump and a hydraulic accumulator to compress gases in gas form. The accumulator is divided into a hydraulic chamber and a pneumatic chamber. The pneumatic chamber of the accumulator can be pneumatically connected to a gas supply and a gas receptacle that needs filled. One-way check valves are used to permit the flow of gas from the gas supply to the pneumatic chamber and from the pneumatic chamber to the gas receptacle, but to prevent the flow of gas in the opposite directions. A motor drives the hydraulic pump, which moves pressurized oil into the hydraulic chamber of the accumulator. The pressurized oil

within the hydraulic chamber of the accumulator compresses the gas within the pneumatic chamber of the accumulator, forcing the gas into a tank or other receptacle that needs filled. The invention can be used to compress a variety of gases at different flow rates, volumes, and pressures. The hydraulic pump can be driven by a single-phase or three-phase electric motor, or a gas or diesel powered motor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic of the gas pressure intensifier system according to present invention.

FIG. **2** is a cross-sectional detail view of a preferred embodiment of a bladder-type accumulator for use in the present invention.

FIG. **3** is a perspective view of a preferred unit embodying the gas pressure intensifier system according the present invention.

FIG. **4** is a representational view of a preferred embodiment of the pneumatic components of the present invention.

FIG. **5** is a representational view of a preferred embodiment of the hydraulic components of the present invention.

FIG. **6A** is a top view of a preferred embodiment of a manifold used in the present invention.

FIG. **6B** is a side view of the manifold of FIG. **6A**.

FIG. **7** is a perspective view of the manifold of FIG. **6A**.

FIG. **8** is a cross-sectional detail of a preferred embodiment of a heat sink used in the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Shown generally in the drawings is a preferred embodiment of a gas pressure intensifier system **10** according to the present invention. FIG. **1** shows a hydraulic/pneumatic schematic of the preferred intensifier system **10**. The primary components of the system **10** are: a gas source **12**, an accumulator **14** that receives gas from the source **12**, a hydraulic pump **16** that is used to pressurize hydraulic fluid within the accumulator **14** and thereby pressurize the gas in the accumulator **14**, and a gas receptacle **18** for receiving pressurized gas from the accumulator **14**.

The gas source **12** is connected to a pneumatic input port **22**. The pneumatic input port **22** is pneumatically connected to a first check valve **24**. The first check valve **24** is a one way valve that permits gas to flow across the valve **24** from the gas source **12** towards the accumulator **14**, but will not permit flow across the valve **24** back into the gas source **12**. A second check valve **26** permits flow across the valve **26** through an output hose **74** into the receptacle **18**, but prevents flow in the opposite direction. The accumulator **14** is pneumatically connected between the first and second check valves **24**, **26**.

The details of the accumulator **14** are best seen in FIG. **2**. The accumulator is divided into a pneumatic chamber **28** and a hydraulic chamber **30**. In the preferred embodiment, a flexible bladder **32** divides accumulator into the two chambers **28**, **30**. The pneumatic chamber **28** is formed by the inside of the bladder **32**. A gas valve **34** connects the connector hose **23** with the pneumatic chamber **28** formed by the bladder **32**. The flexible bladder **32** is contained within a hard shell **36**. A fluid port **38** is provided at the end of the shell **36** opposite from the gas valve **34** to receive a supply of pressurized hydraulic fluid. The hydraulic chamber **30** is formed by the space between the outside of the bladder **32** and the inside of the shell **36**. While a bladder-type accumulator is preferred, persons of ordinary skill in the art will understand that it may be possible to substitute a diaphragm or piston-type accumulator.

The fluid port **38** is connected to a hydraulic circuit **40** that controls the pressure of hydraulic fluid within the hydraulic chamber **30**. The hydraulic circuit **40** includes the pump **16**, a heat exchanger **42**, a hydraulic control valve **44**, and a pressure relief valve **47**. The hydraulic control valve **44** is used to route the pressurized hydraulic fluid. When the control valve **44** is energized into an open position, the pressurized hydraulic fluid is routed into the hydraulic chamber **30** of the accumulator **14**. When the control valve is in a closed position, the hydraulic fluid is routed across the heat exchanger **42** back to the hydraulic reservoir. When the control valve **44** is in the closed position, the hydraulic fluid within the hydraulic chamber **30** is permitted to drain to a hydraulic reservoir. The hydraulic control valve **44** can be cycled between the open and closed positions to periodically increase and decrease the pressure within the hydraulic chamber **30** when the pump **16** is running.

To use the intensifier system **10** described above, the gas source **12** is connected to the input port **22**. The output hose **74** is connected to the receptacle **18**. Typically, the gas source **12** will have a valve that needs to be opened to permit gas from the gas source to flow into the input hose **22**. Once the gas source **12** is in connection with the input hose, and opened to permit flow into the input hose, the gas will flow across the first check valve **24** into the pneumatic chamber **28**, until the pressure in the pneumatic chamber equalizes with the pressure in the gas source **12**. The gas cannot flow back into the gas source because the first check valve **24** will not permit flow in that direction. If the pressure in the pneumatic chamber **28** is greater than the pressure in the gas receptacle **18**, the gas will flow across the second check valve **26** into the gas receptacle **18** until the pressure in the pneumatic chamber **28** and the gas receptacle **18** are equalized.

With the system pneumatically connected as described in the immediately preceding paragraph is it possible to begin pumping pressurized gas into the gas receptacle **18**. To begin this process the pump **16** is engaged to pressurize the hydraulic fluid within the hydraulic circuit **40**. The pump **16** pushes the hydraulic fluid across the control valve **44**. With the control valve in the open position, the pressurized hydraulic fluid flows into the hydraulic chamber **30** of the accumulator **14**. When the pressure in the hydraulic chamber **30** becomes greater than the initial pressure in the pneumatic chamber **28**, the pressure difference across the bladder **32** causes the bladder **32** to collapse within the accumulator **14**, thereby compressing the gas within the pneumatic chamber **28**. When the gas within the pneumatic chamber **28** is compressed to a pressure greater than the pressure within the gas receptacle **18**, the gas will flow across the second check valve **26** and into the gas receptacle **18**. The first check valve **24** prevents the gas from flowing back into the gas source **12**. The hydraulic control valve **44** can then be cycled to the closed position, which diverts the pressurized hydraulic fluid from the pump **16** back to the reservoir **90** across a heat exchanger **42** to cool the hydraulic fluid. With the hydraulic control valve **44** in the closed position, the hydraulic fluid within the hydraulic chamber **30** of the accumulator **14** will drain back to the reservoir, thereby dropping the pressure within the accumulator **14**. Once the pressure within the accumulator drops below the pressure within the gas source **12**, gas will flow from the gas source **12** across the first check valve **24** to fill the pneumatic chamber **28** and collapse the hydraulic chamber **30**. The hydraulic control valve **44** can then be moved back to the open position to repeat the cycle and pump the gas within the pneumatic chamber **28** into the gas receptacle **18**. This process can be repeated until the gas receptacle **18** is filled to a desired pressure.

This is a unique and unintended use for the accumulator **14**. The standard uses for accumulators are: to store power for intermittent duty cycles, to provide emergency or standby power, to compensate for leakage, to act as shock absorbers, or to dampen pulsations in a hydraulic system. Using the movement of the bladder **32** to compress a gas is a way of transforming the power of a hydraulic pump into a gas compressor.

Thus far what has been described is a generalized intensifier system **10** that is expected to have wide application in providing pressurized gas. A specific preferred embodiment of the intensifier system **10** has been developed that is adapted for use in charging nitrogen vessels, such as equilibrators or equalizers in artillery. Details of this preferred embodiment is shown in FIGS. **4**–**8**.

FIG. **4** shows the pneumatic portion of the pressure intensifier system **10** suited for use in filling nitrogen cylinders. A manifold **54** is used to direct the flow of gas. The manifold **54**, shown in detail in FIGS. **6**A, **6**B, and **7** is in the shape of a rectilinear six-sided block. Preferably the manifold **54** is manufactured out of a hard, gas impermeable material such as 1018 steel. The manifold **54** is provided with two longitudinal bores—an input bore **56** and an output bore **58**—that go most, but not all, of the way through the manifold **54**. The input bore **56** is intersected near its terminus by a transverse bore **60**. The output bore **58** is intersected by a pair of transverse bores **62**, **64**.

A T-connector is provided in sealed engagement with the transverse bore **60** that connects with the input bore **56**. One of the free ends of the T-connector is provided with a female quick connect coupling for attachment to the gas source **12**. The other free end of this T-connector is connected to an air hose that connects to the first check valve **24**. The open end of the input bore **56** is connected to a low pressure switch **68**. The low pressure switch **68** is electrically connected to a motor **70** that drives the hydraulic pump **16**. The low pressure switch **68** is normally in an open position, and prevents the motor **70** from running unless it is closed. The low pressure switch **68** is moved to a closed position when the gas pressure within the input bore **56** is above a set minimum pressure. If the pressure within the input bore **56** drops below this set minimum pressure, the low pressure switch **68** opens and turns off the motor **70** to prevent damaging the motor **70** or pump **16** if the gas pressure in the gas source **12** is too low to be used. In the case of the preferred embodiment, the minimum useful pressure of the input gas is about 150 psi.

A male quick connect is pneumatically sealed with transverse bore **62** near the terminus of the output bore **58**. This male quick connect is connectable to an output hose **74** that is equipped with a female quick connect **76** on one of its ends. A gas chuck **78** is provided at the other end of the output hose **74**. The gas chuck **78** is adapted to fit a Schrader Valve that is commonly found on the nitrogen cylinders of Howitzer guns.

A T-connector is pneumatically sealed with transverse bore **64** that extends into the output bore **58**. One of the free ends of this T-connector is attached to a pressure gauge **80** to monitor the pressure of gas within the output bore **58**. The other free end of this T-connector is connected to an air hose that connects to the second check valve **26**. The open end of the output bore **58** is connected to a high pressure switch **82**.

The high pressure switch **82** is electrically connected to the motor **70** that drives the hydraulic pump **16**. The high pressure switch **82** is normally in a closed position, and permits the motor **70** to run unless it is opened. The high pressure switch **68** is moved to an open position when the gas pressure within the input bore **60** is above a set maximum pressure. If the pressure within the input bore **60** raises above this set maximum pressure, the high pressure switch **82** opens and turns off the motor **70** to prevent damaging the system **10**, or any harming people in close proximity to the system **10**. In the case of the preferred embodiment, the maximum pressure is set at approximately 1990 psi.

A pair of elbows **84** connect each of the check valves **24**, **26** to opposing ends of a T-connector **86**. The third end of the T-connector **86** is engaged in a heat sink **88** that is used to dissipate heat from the compressed gas.

The heat sink **88** engages the gas valve **34** on the accumulator **14** to form a pneumatic connection between the check valves **24**, **26** and the pneumatic chamber **28** of the accumulator **14**. Details of the heat sink can be seen in FIG. **8**. The preferred heat sink **88** is formed from a single piece of metal that has a high heat conductivity, and is provided with a series of fins **89** to increase the surface area of the heat sink **88**.

The gas source **12** is in this case a nitrogen supply tank that includes a regulator line **46** with a regulator adjusting valve **48** to selectively open and close the regulator line **46**. The regulator line **46** is provided with a male quick connect coupling **50** on its terminal end. The regulator line **46** can be attached to the pressure intensifier system **10** by connecting the male quick connect coupling **50** to the female quick connect coupling **66** attached to the input bore **56** of the manifold **54**.

A nitrogen extraction kit **98** may be provided between the second check valve **26** and the gas receptacle **18**. The nitrogen extraction kit **98** is used to allow the system to extract and purify nitrogen from the receptacle **18**. This prevents the gas in the receptacle **18** from being wasted if it is necessary to bleed the pressure off the gas receptacle **18** for any reason such as cleaning.

FIG. **5** shows the hydraulic circuit **40** of the preferred embodiment used to fill nitrogen cylinders. A hydraulic pump **16** is driven by an electric motor **70**. In the preferred embodiment, the pump **16** and motor **70** are provided in a single unit. The motor is a 1.5 horsepower, 1725 rpm, single-phase electric motor. A variety of different motors would be acceptable, including three phase, gas, or diesel motors. The pump in the preferred embodiment will move approximately 1.2 gallons of hydraulic fluid per minute at 1725 rpm. It is rated to produce 2000 psi in continuous duty and up to 3000 psi intermittently. A pressure relief valve **47** is provided on the high pressure side of the pump **16** to prevent the pressure in the hydraulic lines from getting too high. In the preferred embodiment, this pressure relief valve **47** is set to open at pressures above approximately 2100 psi. Obviously, components of different specifications can be used depending on the volumes and pressures of gas that are needed.

The pump **16** pumps hydraulic fluid from the reservoir tank **90** into the hydraulic control valve **44**. The hydraulic control valve **44** is a four-way two-position valve. The control valve **44** is adjusted by an electric solenoid within the control valve **44**. When solenoid is energized, the control valve is adjusted into an open position that directs the hydraulic fluid into the accumulator **14**. When the solenoid is not energized, the control valve **44** returns to its steady-state closed position. When the control valve **44** is in the closed position, the hydraulic fluid coming into the control valve **44** from the pump **16** is directed across the heat exchanger **42** back to the reservoir tank **90**. The control valve **44** is provided with an adjustable needle valve **45** that permits any hydraulic fluid within the accumulator **14** to drain out of the accumulator and back to the reservoir tank **90**. The adjustable needle valve **45** can be adjusted to control the rate of flow of hydraulic fluid from the accumulator to the reservoir tank **90**.

The heat exchanger **42** may be equipped with a fan **100** to improve the heat dissipation of the heat exchanger **42**. In the preferred embodiment, the fan **100** is driven by the same motor **70** that drives the pump **16**. Alternatively, the fan **100** may be provided with its own electric motor **102**.

The control valve **44** is provided with a timer **92** that cycles the solenoid on and off to adjust the position of the control valve **44**. In the preferred embodiment, the timer is set such that the solenoid is repeatedly energized for ten seconds and then unenergized for eight seconds. Therefore, for ten seconds, while the control valve **44** is in the open position, the pump **16** pumps hydraulic fluid into the hydraulic chamber **30** of the accumulator **14**. During this phase, the hydraulic fluid collapses the bladder **32** within the accumlator **14** to compress the gas within the pneumatic chamber **28**. When the pressure in the gas in the pneumatic chamber **28** exceeds the pressure of the gas in the gas receptacle **18**, gas will flow across the second check valve **26**, and into the gas receptacle **18**. Notice that the first check valve **24** prevents the gas from flowing back into the gas source **12**. When the solenoid is not energized, the control valve **44** moves back to the closed position, the pressure within the hydraulic chamber **30** drops, and the hydraulic fluid is forced out of the accumulator **14** by the gas pressure expanding the bladder **32**. As the gas expands to occupy the space evacuated by the draining hydraulic fluid, its pressure drops. When the pressure in the pneumatic chamber drops below the pressure of gas in the gas supply **12**, gas flows from the gas source **12** across the first check valve **24** into the pneumatic chamber **28**. The cycle is then repeated, until the desired pressure in the gas receptacle **18** is reached. The pressure within the gas receptacle **18** can be determined by viewing the pressure gauge **80**. Persons of ordinary skill will understand the approximate times needed to cycle the control valve **44** between the open and closed positions to achieve the desired pressures. It will depend on the size of the accumulator, the power of the pump, the efficiency of the pump, the amount of gas contained in the lines between the components of the system, and other factors. It may be necessary to adjust the exact timing based on trial and error until a preferred timing is determined.

Persons of ordinary skill in the art will appreciate various ways of controlling the components of the system. It is preferred to have an on-off momentary switch to complete a circuit that electrically energizes the pump motor **70**, the heat exchanger motor **102**, and the timer **92** and solenoid of the control valve **44**. The on-off momentary switch can then be used to start and stop the compressing process. The low and high pressure switches **68** & **82** are in line with the momentary switch to cut-off power to the pump motor **70**, the heat exchanger motor **102**, and the timer **92** and solenoid of the control valve **44** if the pressure in the gas source **12** gets too low or the pressure in the gas receptacle **18** reaches the set maximum level.

As seen in FIG. **3**, the components of the gas pressure intensifier system may be combined in a single portable unit **94**. To accomplish this, the components are mounted to a frame **97**, and then protected by a cover **96**. Preferably the cover **96** is provided with an opening to allow for inspection of the pressure gauge **80**. In the preferred embodiment, the frame and cover **96** are made of steel. Persons of ordinary skill in the art will be aware of numerous arrangements for the components of the system **10**.

To operate the specific embodiment described above, an operator should first add hydraulic fluid to the reservoir **90**. In the preferred embodiment 3.75 quarts of oil are used as the hydraulic fluid, specifically, the preferred hydraulic fluid is (MIL-PRF-6083F). Those of ordinary skill in the art will be aware of alternative hydraulic fluids. After adding the hydraulic fluid to the reservoir (or verifying that it is still at an appropriate level after the first use), the gas chuck **78** of the output hose **74** should be attached to the gas receptacle **18** that is being filled. Typically, the gas receptacle will have a Schrader Valve for the gas chuck **78** to attach to. Next, the male quick connect **50** from the regulator line **46** of the supply tank **12** is attached to the female quick connect **66** that is connected to the input bore **56** of the manifold **54**. The Schrader Valve on the gas receptacle **18** can then be adjusted to an open position. The regulator adjusting valve **48** on the supply tank **12** should then be slowly opened to let gas from the supply tank **12** flow into the system **10**. If the pressure in the supply tank **12** is greater than the pressure in the gas receptacle **18**, then the operator should wait a few moments until the pressure in the tanks **12** & **18** equilibrates. The momentary switch can then be turned on to energize the pump motor **70**, the heat exchanger fan motor **102**, and the control valve **44** and timer **92**. The pump **16** will then begin to pump hydraulic fluid through the hydraulic circuit **40**, and the system **10** will operate as described above. The pressure in the gas receptacle can be monitor by observing the pressure gauge **80**. When the pressure reaches the desired level, the momentary switch should be moved to the off position to shut off all of the electrical components of the system **10**. The Schrader Valve on the gas receptacle and the adjustable valve **48** on the supply tank **12** should then be closed. The pressure in the pneumatic lines should be slowly bled off by cracking the fitting on the gas chuck **78** attached to the gas receptacle **18**. The operator should verify that the pressure has been released by checking that the pressure gauge **80** shows 0 (zero) psi. After it has been verified that the pressure in the pneumatic lines has been released, the output line **74** can be removed from the gas receptacle **18**. The gas chuck **78** can then be attached to another gas receptacle **18** that needs to be filled an the process can be repeated. If no more gas receptacles need filling, then the regulator line **46** of the supply tank **12** can be removed from the input port **22**.

Thus, it can be seen that the above-described invention provides a method and apparatus that permits filling of depleted receptacle tanks through the use of supply cylinders, even when the pressure in the supply cylinder is below the desired pressure of the tank. It should be understood that the foregoing description relates to a preferred embodiment of the invention. Modifications and deviations from this preferred embodiment will be obvious to those of skill in the art without departing from the invention. For example, while most of the discussion has focused on using the intensifier system **10** to fill rechargeable receptacle tanks, the system **10** could be used to provide compressed gas for nearly any purpose.

We claim:

1. A method of filling a gas receptacle to a desired pressure, the method comprising:

providing an accumulator, said accumulator having a pneumatic chamber and a hydraulic chamber;

providing a gas receptacle;

providing a gas supply;

pneumatically connecting said gas supply to said pneumatic chamber of said accumulator such that gas can flow from said gas supply to said pneumatic chamber but cannot flow from said pneumatic chamber to said gas supply;

pneumatically connecting said gas receptacle to said pneumatic chamber of said accumulator such that gas can flow from said pneumatic chamber to said gas receptacle but cannot flow from said gas receptacle to said pneumatic chamber;

permitting a portion of gas to flow from said gas supply to said pneumatic chamber at an initial pressure;

pressurizing hydraulic fluid within said hydraulic chamber to thereby compress and pressurize said portion of gas within said pneumatic chamber to an elevated pressure, thereby causing at least some of said portion of gas to flow into said gas receptacle;

repeating said permitting and pressurizing steps until the pressure in said gas receptacle reaches the desired pressure; and

providing a low pressure switch which will terminate said pressurizing step if said initial pressure of said portion of gas is below a specified minimum pressure.

2. The method according to claim **1**, wherein said accumulator is a bladder-type accumulator, wherein said bladder-type accumulator has a bladder having an inside and an outside, and wherein said inside of said bladder forms said pneumatic chamber.

3. The method according to claim **1**, further comprising providing a hydraulic circuit including a pressure relief valve and a hydraulic pump, said hydraulic circuit connecting said hydraulic pump with said hydraulic chamber of said accumulator.

4. The method according to claim **3**, wherein said hydraulic circuit further comprises a two-position valve, said two-position valve for directing hydraulic fluid to said hydraulic chamber when said two-position valve is in a pressurizing position, said two-position valve permitting said hydraulic fluid to drain out of said hydraulic chamber when said two-position valve is in a draining position.

5. The method according to claim **4**, wherein said hydraulic circuit includes a heat exchanger between said two-position valve a said drain reservoir.

6. The method according to claim **1**, further comprising

providing a high pressure switch which will terminate said pressurizing step if said elevated pressure is greater than a maximum pressure.

7. The method according to claim **1**, wherein said repeating step is initiated by a timer.

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